The temperature at Blue Hill was about 25° C. At 8 p. m. it was 18.9°, the dew point 16.7°, and the maximum of the day 28.3° C. Therefore, the height of the potential cumulus base was about 1,000 m. above Blue Hill, or 1,200 m. above sea level. Thus, the fire-formed cloud seems to have been but little, if any, higher than the elevation at which clouds would have formed naturally.

The fifth example was observed at Lindenburg, Germany, on July 29, 1917, by Dr. H. Hergesell, and a description with a photograph was published by him in Das Wetter, August–September, 1917, pages 178–179. On that date a large forest fire occurred and the smoke cloud, mounting to 1,255 meters, became limited, for the most part, by an inversion of temperature (observed by kites at 1,000–1,200 meters). Over the hottest part of the fire, however, the upcurrent was warm enough, with the aid of the latent heat from condensation, to push through this limiting inversion layer and to form a cumulus cloud with an apex rising to 1,800 meters.

The last example is that given by Mr. Reichelt on page 144 of this issue of the REVIEW. The height of the base of the cloud observed was about 1,500 feet and that of the top 2,500 feet (approximately 450 and 750 meters, respectively). From the data as to temperature and humidity given, the height of the potential base of cumulus clouds at that time was 750–850 meters. Thus it seems that the moisture contained in the burning leaves added so much humidity to the air that even at the high temperature of the rising column, condensation took place appreciably lower than would have resulted from fireless convection.

From these examples, it appears that the height at which cumulus clouds will form over fires depends largely on the dryness of the hot air ascending from the fire; and, therefore, that the height of the cloud base is generally greater over burning buildings than the height of the potential base if there were normal convection, but less over burning leaves or other material containing much water.

RESULTS OF OBSERVATIONS OF CLOUDS DURING THE SOLAR ECLIPSE JUNE 8, 1918.

By S. P. FERGUSSON, Meteorologist.

[Dated: Weather Bureau, Washington, D. C., May 3, 1919.]

Observations of the kind, amount, direction (azimuth), relative velocity, and position of clouds were received from 17 stations equipped with nephoscopes and located within or near the zone of 90 per cent totality: also, there are available at these and other stations, notes concerning changes in appearance of clouds, unusual phenomena, etc. At two stations nephoscopes were improvised by the observers, and at a third azimuths were observed by means of a compass.

Observations of azimuth, etc., were made every half hour from noon local standard time until the last regular observation of the day, except during the period beginning an hour before and ending an hour after totality, when they were made every 10 minutes.

Table 1 contains all the data of azimuth and relative velocity of clouds observed continuously during the eclipse, excepting those at stations reporting severe thunderstorms and stations where no change of condition was observed. The data from the latter are referred to in the notes accompanying the table.

In figure 1 the actual observations of azimuth, as made, are plotted with reference to the position of the shadow according to the method employed in the study of the winds and described in the REVIEW for January, 1919, **47**: 12–13. The data are given for each 10-minute interval before and after totality.

As in the instance of the wind at the earth's surface, it is to be expected that the direction of motion of the lower clouds, and perhaps, under extremely favorable circumstances, that of the upper clouds, will be affected by the eclipse-shadow. However, since the mean velocity of the wind in which the clouds float is higher than that of the surface wind, the influence of the shadow will be definitely measurable only when the velocities of the upper air are relatively slow or below normal. In the instance of the lower clouds accurate measures of the direction often are difficult to obtain, particularly when the conditions are favorable for local storms and the complex movements, horizontal and vertical, of parts of the same cloud are likely to be confused with the general drift of the air. In one important respect observations of clouds are of greater value than records of wind at the surface; they indicate motions of the free air uninfluenced by local topography (mountains, buildings, etc.).

As stated in the discussion of the winds recorded during the eclipse, the meteorological conditions generally near the shadow-path, were unfavorable for this study because of thunderstorms and other local phenomena, and for this reason many of the records of cloud observations could not be used. One very favorable circumstance was that the velocities of clouds in nearly all instances were unusually low.

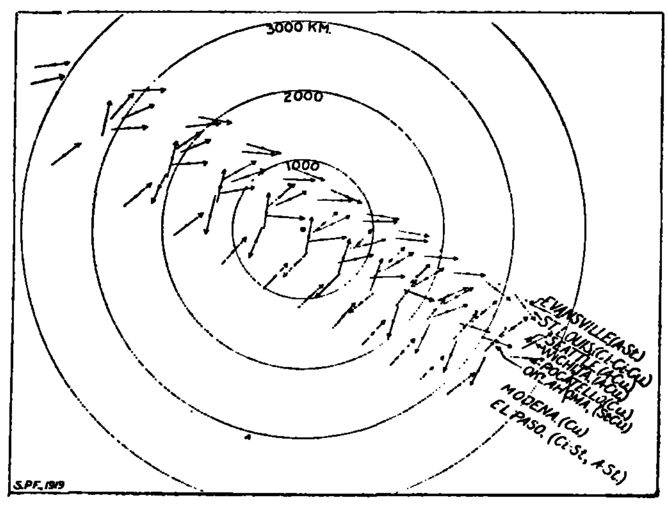

FIG. 1.—Changes in the directions of clouds during the solar eclipse, June 8, 1919.

No data of diurnal variations of the direction and relative velocity of clouds are available for the United States except in New England. Averages of hourly observations at Blue Hill Observatory show that the direction of the upper clouds tends to become more westerly in the early afternoon and return to the original point toward evening. For example, clouds moving from azimuth 130° at 10 a. m. would very probably change to 110° at 1 p. m. and back to 130° by 6 p. m. It is reasonable to suppose that the same kinds of clouds follow the same general law, at least approximately, at stations in other parts of this country; but, in view of the facts that these diurnal periods are small and that unusual conditions prevailed on June 8, it is considered inadvisable to attempt to apply corrections. The average duration of the eclipse at any station was about two hours and the difference in the time of occurrence of totality, between the Pacific coast and Florida, about three hours, consequently it should be possible, with a large number of observations, to ascertain any measurable influence of the eclipse regardless of diurnal changes in direction or velocity.

Referring to the directions of clouds plotted in figure 1, it is quite apparent that slight changes in the directions of the upper currents are indicated, of which the amplitude was smallest at the cirrus level (9,500 meters), larger at the cirro-cumulus and alto-stratus level (7,500 to 5,000 meters), and largest at the cumulus level, which, under the conditions prevailing on June 8, was higher than usual and probably at least 2,000 meters above sea level. Generally, the changes in the directions of the clouds resemble the changes in the direction of the surface wind indicated in figure 6, published in the REVIEW for January, 1919, **47**:13. At St. Louis and Evansville, where cirro-strati were observed, the eclipse occurred late in the afternoon, and since the influence of the shadow must have been small, it is possible that the slight changes reported are the usual variations to be expected between individual observations; but it is significant that these slight variations of direction are in agreement with the changes observed at other stations.

The observations of relative velocity are somewhat irregular and are insufficient in number for the purpose of determining resultant directions and velocities. To obtain accurate or comparable resultants it is necessary to know the actual height and velocity of the clouds at least approximately; and no trustworthy data are available. The heights of the cumulus and strato-cumulus bases could be computed from observations of the dewpoint, but separate observations of the tops and bases were not made on June 8, and since on that day the vertical extent of these clouds was considerable, resultants computed from existing data would very probably be uncertain. It seems likely that some of the irregularities in the relative velocities may be accounted for by assuming that successive observations were made on parts of clouds differing considerably in height.

The relative velocities of the cumulus and strato-cumulus indicates a tendency toward a minimum near totality; and the data from Pocatello, directly in the eclipse track, and Oklahoma, a little to the south of the track, show several maxima and minima. The alto-stratus observed at El Paso indicates a slight minimum 10 minutes after totality followed by a maximum 35 minutes after totality. The relative velocity of the alto-cumulus at Wichita increased steadily to a maximum near totality and thereafter decreased slowly.

Summary.—The results of observations of clouds during the eclipse of June 8, 1918, indicate that the moon's shadow causes a slight change in the condition of the atmosphere even at considerable heights above the earth's surface.

It is possible that studies of these phenomena may be of importance to meteorology for the reasons that the data are of actual changes of condition of the free atmosphere due to a single cause—the temporary cooling of the air—uninfluenced by errors due to topography (mountains, buildings, etc.), that so often vitiate records obtained at the surface of the earth. The equipment required for an intensive study of eclipses is simple and inexpensive, and if ample time is allowed for preparation it is believed that further effort in this field will be more than justified.

TABLE 1.—*Azimuth and relative velocity of clouds during the solar eclipse, June 8, 1918.*

Station.		Kind of cloud.	Minutes before totality.											Minutes after totality.										
			105	95	85	75	65	55	45	35	25	15	5	5	15	25	30	35	45	55	65	75	85	95
Seattle	Az.	A.-Cu.			62			65	45	55	45	50	50	60	55	40	45	45	40	50				
	R. V.																							
Pocatello	Az.	Cu.		98		94	110	110	70	110	88	78	84	95	80	85	85	78	76	80				
	R. V.			23		15	16	20	15	20	26	20		23	22	28	25	24	18	16				
Reno	Az.	Cu.		10			20	20	10	0	0	0	0	10	10	10	15	15						
	R. V.																							
Modena	Az.	St.-Cu.						206	202	205	197	230	225	223	202	193	205				235			200
	R. V.							3	3	2	2	2	2	2	2	2	2				3			3
El Paso	Az.	A.-St.		49			56	58	56	57	58	58	60	54	56	57	52	50	53			51		
	R. V.			7			9	8	8	9	8	9	8	7	7	6	8	8	7			7		
Wichita	Az.	A.-Cu.			70		53	48	58	58	58	75	65	65	70	66	66	83	83	87		87		
	R. V.				8		12	10	12	12	12	13	14	14	13	12	12	12	12	10		10		
Oklahoma	Az.	St.-Cu.		21			43	41	40	38	19	18	10	8	15	15	18	18						
	R. V.			32			22	18	22	24	18	19	22	24	12	18	18	8						
Kansas City	Az.	Cu.				12	12	12	12	12	12	11	11	11	11	11	11	10	8	8		8		
	R. V.																							
St. Louis	Az.	Ci.-St.					141	126	95	93	95		89	92	96	84		89	94	97				
	R. V.							12	5	7	5		6	8	4	5		4	6	5				
Evansville	Az.	Ci.-St.	108			114					99	100	114	111	109	110								
	R. V.		10			12					15	10(?)	16											

The azimuth (or direction from which the clouds move) is expressed in degrees, beginning with south (0° or 360°) and reading clockwise through west (90°), north (180°), and east (270°) to south. The relative velocity is the distance, in millimeters, traveled in 25 seconds by the cloud image when the eye of the observer is 12 centimeters above the mirror of the nephoscope.

NOTES.

Seattle, Wash.—Azimuths of clouds were obtained by means of a nephoscope devised by Mr. H. W. McKenzie: instrument accurately graduated to 5°.

Portland, Oreg.—At 3:23 p. m. A.-Cu. clouds rapidly grew heavier, and at 3:33 were changing to St.-Cu. At 3:43 strange stratified clouds appeared suddenly in the northwest, long thin lines extending from southwest to northeast. These clouds covered about 0.3 of the sky and were unlike any clouds the observers remember having seen. This unusual cloud disappeared at 3:53 p. m. At 4:03 p. m. St.-Cu. began to change back to A.-Cu. This change may have been apparent and caused by the change in light as the eclipse progressed, but was noted by two observers. (See description of a somewhat similar phenomenon p. 152 below.)

Reno, Nev.—Observations of Ci. and Ci.-St. also were made, but these show a uniform change of azimuth from 70° at 12 m. to 95° at 4:56 p. m.

Roswell, N. Mex.—Observations of the azimuth of Ci.-St., A.-St., and Cu. were made by means of a pocket compass. The azimuth of the Ci.-St. and A.-St. changed uniformly from 170° at 11 a. m. to 120° at 6 p. m., while during the same interval that of the Cu. changed uniformly from 220° to 270°.

Kansas City, Mo.—The azimuths of clouds were obtained by means of a nephoscope constructed by the observers, Messrs, Connor and Anderson. A circular scale ruled to degrees was fitted to a mirror 9 centimeters in diameter.